What is claimed is:

1. An electron device which controls quantum chaos comprising:

a heterojunction which is provided with

a first region having an electron system characterized by quantum chaos and

a second region having an electron system characterized by integrability,

the first region and the second region being adjacent to each other, and

the heterojunction being capable of exchanging electrons between the first region and the second region, wherein

a quantum chaos property of an electron system in a system formed of the first region and the second region is controlled by applying to the heterojunction an electric field having a component perpendicular to at least a junction surface.

2. The electron device which controls quantum chaos according to claim 1, further comprising an electrode for applying the electric field to the heterojunction.

3. The electron device which controls quantum chaos according to claim 1, wherein

the first region is in a metallic state, and

the second region has a random medium.

4. The electron device which controls quantum chaos

according to claim 1, wherein

the first region is in a metallic state, and

a random magnetic field is present in the second region.

5. The electron device which controls quantum chaos according to claim 4, wherein

a magnetic impurity is added to the second region.

6. The electron device which controls quantum chaos according to claim 1, wherein

a maximum length of the heterojunction in a direction along the junction surface is equal to or less than a coherence length of electrons.

7. The electron device which controls quantum chaos according to claim 1, wherein

each of the first region and the second region has the shape of a layer.

8. The electron device which controls quantum chaos according to claim 7, wherein

the electrode for applying electric field to the heterojunction is formed, via an insulating film, on at least one of the first region and the second region each having the layer shape.

9. The electron device which controls quantum chaos according to claim 1, wherein

the quantum chaos property of the electron system of the system formed of the first region and the second region is

controlled by setting a Fermi level of the electron system to a predetermined value in addition to the application of electric field.

10. The electron device which controls quantum chaos according to claim 9, wherein

the Fermi level is set to the predetermined value by controlling a density of the electron system.

11. The electron device which controls quantum chaos according to claim 9, wherein

critical electric field intensity with which a transition from quantum chaos to an integrable system occurs is controlled by the control on the Fermi level.

12. The electron device which controls quantum chaos according to claim 1, wherein

a transfer between the first region and the second region is equal to or less than a transfer of the first region and a transfer of the second region.

13. The electron device which controls quantum chaos according to claim 12, further comprising a tunnel barrier region formed between the first region and the second region.

14. The electron device which controls quantum chaos according to claim 13, wherein

each of the first region and the second region is formed from a semiconductor and

the tunnel barrier region is formed from a semiconductor

of which energy at a bottom of a conductive band is higher than that of the semiconductor used for forming the first region and the second region.

15. The electron device which controls quantum chaos according to claim 13, wherein

each of the first region and the second region is formed from GaAs or InGaAs and

the tunnel barrier region is formed from AlGaAs.

16. The electron device which controls quantum chaos according to claim 1, comprising a double heterojunction which is provided with the second region and the first regions disposed on each sides of the second region.

17. The electron device which controls quantum chaos according to claim 16, wherein

tunnel barrier regions are provided between the first region and the second region.

18. The electron device which controls quantum chaos according to claim 17, wherein

each of the first regions and the second region is formed from a semiconductor and

each of the tunnel barrier regions is formed from a semiconductor of which energy at a bottom of a conductive band is higher than that of the semiconductor used for forming the first regions and the second region.

19. The electron device which controls quantum chaos

according to claim 17, wherein

each of the first regions and the second region is formed from GaAs or InGaAs and

the tunnel barrier regions are formed from AlGaAs.

20. A quantum chaos control method comprising:

using a heterojunction which is provided with a first region having an electron system characterized by quantum chaos and a second region having an electron system characterized by integrability, the first region and the second region being adjacent to each other, and the heterojunction being capable of exchanging electrons between the first region and the second region, and

controlling a quantum chaos property of an electron system in a system formed of the first region and the second region by applying to the heterojunction an electric field having a component perpendicular to at least a junction surface.

21. The quantum chaos control method according to claim 20, wherein

the quantum chaos property of the electron system of the system formed of the first region and the second region is controlled by setting a Fermi level of the electron system to a predetermined value in addition to the application of electric field.

22. The quantum chaos control method according to claim

20, wherein

a transfer between the first region and the second region is equal to or less than a transfer of the first region and a transfer of the second region.